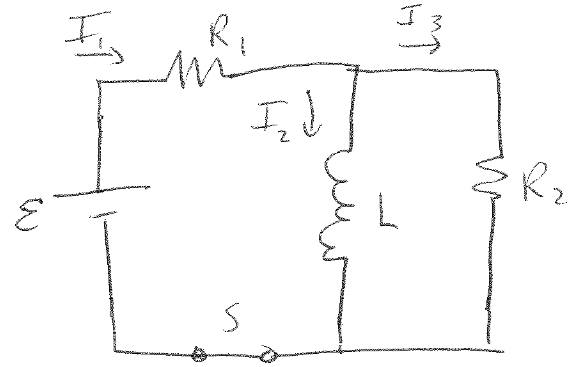
Ch 14. Prob 58 (#1)



Find $I_1, I_2 + I_3$ when

a) Swith is first closed

Initially no current is flowing ~~to~~ through the inductor and it will generate a ~~...~~ voltage to keep it that way

$\therefore$ $V_L = V_{R_2}$ and $I_2 = 0A$

By Kirchoff's Law

$I_1 = I_2 + I_3 \longrightarrow I_1 = I_3$

$\mathcal{E} - I_1 R_1 - I_3 R_3 = 0$

so $\mathcal{E} - I_1 R_1 - I_1 R_3 = 0$

$\mathcal{E} = I_1 (R_1 + R_3) \Rightarrow \boxed{I_1 = \frac{\mathcal{E}}{R_1 + R_3}}$

$\boxed{I_2 = 0}$

$\boxed{I_3 = \frac{\mathcal{E}}{R_1 + R_3}}$

b) Steady state value

If current is not changing then the voltage across the inductor is 0.

so $V_L = 0$ and $V_{R_2} = 0$

But $V_{R_2} = I_3 \cdot R_2 \quad \therefore \quad I_3 = 0$

Since $I_1 = I_2 + I_3$ Then $I_1 = I_2$

By Kirchoff's law

$\mathcal{E} - I_1 R_1 - V_L = 0$

$\mathcal{E} - I_1 R_1 = 0 \longrightarrow I_1 = \frac{\mathcal{E}}{R_1}$

so $\boxed{I_1 = \frac{\mathcal{E}}{R_1}}$ $\boxed{I_2 = \frac{\mathcal{E}}{R_1}}$ $\boxed{I_3 = 0}$

c) Instant after the switch is reopened

Since before the switch is opened

$$V_L = 0$$

you would think everything is zero; however, before the switch is opened $I_2 = \frac{\varepsilon}{R_1}$

∴ After the switch is opened, the inductor maintains the current.

with the switch open $\boxed{I_1 = 0}$

$$I_1 = I_2 + I_3 = 0 \quad \therefore \quad I_2 = -I_3$$

If $\boxed{I_2 = \frac{\varepsilon}{R_1}}$, then $\boxed{I_3 = -\frac{\varepsilon}{R_1}}$